Medicare Participating Heart Bypass Center Demonstration:

Evaluation Design

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EVALUATION OF MEDICARE PARTICIPATING HEART BYPASS CENTER DEMONSTRATION:

Design Report

1.0 INTRODUCTION

This report summarizes our proposed methodology for evaluating the Medicare Heart Bypass Demonstration. We begin by summarizing the nature of the demo, how many sites will participate, and other background information, in order to target the hypotheses and plan the data collection. Section 3 models our expectations of behavioral responses on the part of Participating Heart Bypass Centers (PHBCs). Special emphasis is given to the participation decision because it is key in determining site application and selection bias that may affect the internal and external validity of our evaluation findings.

We have slightly revised our original technical evaluation proposal to explicitly recognize three modules: (1) economics; (2) quality and appropriateness; and (3) marketing. The first includes a variety of topics concerning bid offers, the cost of CABG surgery, volume effects on costs, etc. Quality and appropriateness focuses on patient outcomes and patient characteristics influencing the decision to operate or not. Marketing is a crucial aspect of the demonstration in that attracting patients away from higher priced competitors will likely be more problematic than the surgery itself. This section reviews the marketing strategies of each site and focuses on various data to review the impacts of these different strategies.

Besides numerous secondary data such as Medpar and PRO, three primary data collection efforts are proposed: on-site case studies, beneficiary telephone surveys, and referring physician telephone surveys. Our original proposal discussed each of these as distinct activities. In this revised design report, we have subsumed them under each of the three evaluation

modules. For example, the broad section covering marketing now incorporates our entire workplan on this topic, pulling together case study and beneficiary-physician survey data.

The following section (Section 2) discusses the scope and nature of the demonstration. Section 3 explicates the model of behavior under a global payment mechanism. Section 4 describes our plan for evaluating the price, volume, and other economic effects of selecting four PHBCs. Section 5 follows with detailed plans for evaluating the quality of care, outcomes, and case-mix severity indicators pertinent to the demonstration. This section also incorporates our methods for addressing the appropriateness of CABG surgery that was funded through a modification to the original scope of work. Section 6 then presents our evaluation plan for marketing, including a theory of beneficiary choice of demo versus non-demo sites. Section 7 concludes with a revised management plan based on having identified four centers.

2.0 SCOPE AND NATURE OF THE DEMONSTRATION

In designing a technical approach, it is important to have a clear understanding of the structure and limits of the demonstration. At this point, there are four demonstration PHBCs that will be paid on a per case basis for all Part A and (most) physician Part B inpatient services:

1. University Hospital in Boston
2. Ohio State University Hospital in Columbus
3. St. Joseph's Mercy Hospital (Catherine McAuley Health Center) in Ann Arbor
4. St. Joseph's Hospital of Atlanta.

The demonstration is to run for 36 months beginning approximately June 1, 1991. All four hospitals have strong local competitors. Both St. Joseph's hospitals are major players in their markets for CABG surgery, while the two University hospitals are relatively minor providers in their service areas. Only St. Joseph's, Atlanta, is strictly nonteaching, yet it has by far the

largest emphasis on cardiac care (over 60 percent of patients).

There was no mention in the RFP of control groups, although several of the research questions require some benchmarks for comparison. Many of the questions can be answered in an absolute sense using data from the four sites (e.g., Did volume increase in demo hospitals?). However, many others demand additional information from non-demo sites, calling for a quasi-experimental design (e.g., During the demonstration, was quality of care equivalent at demo and non-demo sites? Did volume increase relative to local competitors?). Thus, our design includes extensive collection of secondary claims data.

Finally, a strong emphasis is placed in the RFP on existing Quality Assurance and PRO data in lieu of new medical record abstracting. To the extent possible, our design makes creative use of existing data bases both on quality and costs. In order to address what we think are the key questions while staying within the labor hours specified under contract, we have assumed additional data collection or computer processing by PROs, FIs, and HCFA, as detailed where appropriate. We have also assumed that the four demo sites will provide us with all the financial and medical records data we require at no cost.

3.0 MODEL OF BEHAVIOR UNDER A GLOBAL PAYMENT

The first step in designing an evaluation of the CABG demonstration is to model expected behavior in the demonstration sites. This is important for several reasons. First, behavioral modelling forces us to develop testable hypotheses of effects, both positive and negative. This guides the data to be collected and how they will be used. Second, modelling also forces us to be explicit about the ways in which hospitals and physicians might respond to the programs' incentives. This kind of theorizing is important in any kind of quasi-experimental design in that it forges explicit links between hospital and physician behavior and incentives. Such links, if found, reassure us that the findings have logical antecedents and are not due to other

extraneous factors.

In our original proposal, we specified the behavioral model as a two-stage decision process. First, there is the basic decision to participate. Following this (and assuming selection as a demo site), there are the myriad decisions involving marketing, patient selection, productivity, quality and service mix, and the all-important issue of how to distribute the bundled payment among providers (hospital and physicians).

Because the negotiated bundled hospital and physician price for CABG surgery is such a departure from existing reimbursement, involving major changes in internal coordination and payment controls within the sites, it is important to explain the basic decision to participate. Stated in a somewhat negative way for emphasis, hospitals that are doing well under the current system in terms of reimbursement and quality have little need to apply, while those that might see a benefit to participating may not be the hospitals HCFA wants for the demo. Finally, is the question of selection bias, not at the patient level as it is ordinarily understood, but at the site level. While not necessarily a problem, bias could severely limit the generalizability of the findings to future applicants.

3.1 Decision to Participate

The basic decision to participate (or apply) can be decomposed into a set of static, current considerations as well as a set of dynamic, future expectations. Current considerations can be summed up in the question each applicant must ask itself, "What is in it for us right away?" Very quickly, the answer devolves to an analysis of the level of negotiated prices versus current Part A and B reimbursements. If an applicant group felt that it could negotiate an all-inclusive price that exceeded current total reimbursements, it might apply. For example, if HCFA were to calculate a single national all-inclusive CABG price as the benchmark, many more hospitals might apply. However, the participation guidelines have been very explicit in warning

applicants that they should expect to negotiate rates below their own current reimbursements.

Below current payments, on the other hand, does not mean below current costs. Where CABG surgery is already profitable, other factors may be given more weight in the decision to participate; thereby encouraging participation even at a rate lower than currently paid.

On the Part B side, surgeons and other specialists are paid according to their customaries or prevailing fees, whichever is binding. Like the DRG rates, allowable fees may be above "reservation fees" with some physicians enjoying quasi-rents. Where they are, at least some physicians may be willing to participate and accept slightly lower payments in lieu of other benefits. Alternatively, because physicians, are not a monolithic group, some may see a bundled payment as an opportunity to enhance their reimbursements at the expense of the hospital or other physicians, or they may see the opportunity in sharing some of the Part A profits.

As a general rule, however, no group should be willing to accept a bundled total payment that is less than total current payments unless:

- either the hospital or the medical staff (or some part of the medical staff) see the possibility of sharing in current gains being enjoyed by another group; or
- it expects the volume gains to be substantial enough to lower average costs per operation; or
- it expects to achieve productivity gains relatively painlessly, say, through shorter stays or more ambulatory care that can be charged for separately outside the demonstration, etc.; or
- Surgeons are "demand-bound" in the sense that they would like to do more CABG operations but cannot currently attract more patients even at zero out-of-pocket price; or

- the hospital expects to receive higher reimbursements than it is currently getting for the various cost pass through, e.g., capital.

Most of these dynamic reasons for participating can be summed up in the phrase, "participating will be good for business." Or, in a word, volume.

3.2 Participation Hypotheses

Theory suggests several interesting hypotheses.

Hypothesis 1: *Ceteris parabis*, we expect hospitals with more unused capacity and higher fixed costs to be more likely to apply.

Hospitals and physicians may speak of the added prestige of being a PHBC, but prestige is primarily a means by which the hospital can increase business (volume). Why do hospitals want more business, especially when it is costly to perform open heart surgery? First, volume has tremendous impact on average costs. If the hospital has high fixed costs and underutilized capacity, then variable or marginal costs may be below any price it might negotiate with HCFA. On a strict profit maximization criteria, the hospital will want to participate so long as it can negotiate a price that more than covers variable costs and contrbutes towards fixed coss (e.g., administrative salaries, housekeeping, etc.).

Hypothesis 2: Expected spill-over and prestige effects another patient demand will be important in the hospital's decision to apply.

A second reason why hospitals might value the prestige of being a PHBC is the spillover effect it might have on other patients. If being a Center raises prestige, and this prestige has spillover effects on the hospital's other services, it may even take on more CABG surgery as a loss leader, so to speak, in the hope of gaining other patients who would be more profitable,

or who would cover some of the high fixed costs.

Hypothesis 3: Hospitals with several local CABG competitors will be more likely to apply, controlling for size, teaching status, etc.

A third reason why hospitals might value greater volume by being a Heart Bypass Center is to ward off a local competitor. If a hospital and its surgeons could be sure that another competitor would not become a prestigious Bypass Center, it, too, might be less interested in applying. If both institutions are ignorant of each other's plans, however, both might apply.

Hypothesis 4: Hospitals with a less severe case mix today are more likely to apply; and

Hypothesis 5: HCFA is likely to choose such hospitals as demo sites because their mortality rates are lower (assuming HCFA cannot completely adjust for all relevant risk factors).

Another reason why hospitals might desire to become PHBCs is a less severe case mix. If applicants thought they could successfully identify less costly patients ex ante, they could make profits. This has been the problem with many TEFRA HMOs. Selection bias tends to dominate other financial considerations, either positively or negatively. For reasons discussed below, however, we feel that patient selection bias will not be a serious dynamic problem for the demonstration. Existing selection bias, on the other hand, could be a definite problem.

Hypothesis 6: Hospitals with the majority of their physicians on salary will be more likely to apply.

One major reason for not applying concerns the organizational difficulties of getting the medical staff to agree to participate and accept a bundled payment for all of their services and forego all balance billing. Hospitals with primarily salaried physicians should have a distinct

advantage in that fee-for-service incentives are greatly attenuated.

3.3 Hypothesis Testing: Decision to Participate

In our original proposal we had proposed to conduct a rigorous multivariate analysis of the hospital's decision to participate. This was to involve mailed surveys to all 42 institutions invited to apply. Due to limited financial resources, we have dropped this analysis. As a substitute, we propose to report the responses of the demo sites to questions about why they decided to participate. These responses often conflict with the expected hypotheses stated above. Nevertheless, we have already learned a great deal about the decision process from the successful applicants. What this analysis will lack, of course, are the reasons why many other capable sites decided not to participate. Thus, it will not be clear what incentives could be used to induce these hospitals to apply in the future.

4.0 EVALUATION OF PRICE, VOLUME, COST AND COMPETITIVE EFFECTS

Evaluating the many economic aspects of the demonstration will be done using a combination of secondary and primary data. This section begins with our proposed approach to measuring the volume effects associated with being named a Medicare PHBC (Section 4.1). Section 4.2 then discusses several measures of costs to Medicare, taking into consideration both out-of-demo costs and any costs of redirecting patients to demo facilities. Section 4.3 then details our approach to measuring volume impacts on CABG-related costs in each of the four sites. Section 4.4 describes our plans for measuring the administrative costs of the demo to participants. Section 4.5 then addresses organizational responses to a single bundled rate. These include the way in which payments are allocated to physicians and how sites attempt to control costs. Clinical management of patients is discussed in Chapter 5.

4.1 Sources of Volume Increases

HCFA is very interested in whether the number of CABG patients increases at the demo sites and whether gains are due to (a) the general growth in CABG surgery, or (b) a shift in existing demand away from local (and outside) competitors. If all of the demo's volume increases were due to the growth in CABG surgery generally, then there are no competitive advantages to being a Center. It is also important to know the geographic distribution of patients in order to correctly determine overall net program costs.

4.1.1 Methods

The number of CABG patients in the demo hospital in year t can be decomposed using the following identity:

$$D_{dt} = D_{mt}*[DSH_{mt}] + D_{nmt}*[DSH_{nmt}] \quad (1)$$

where D_{dt} = the total number of CABG patients in the demo hospital in year t; D_{mt} = total CABGs in the demo's market; DSH_{mt} = share of demo hospital CABGs in the local market; D_{nmt} = total CABGs outside the demo market; and DSH_{nmt} = share of demo hospital CABGs from outside its local market, i.e., nationally. For example, if 2,000 CABGs were being done in a given market and the demo site performed 500 on local residents, then it would have 25 percent of the local market. If, in addition, there were 150,000 Medicare CABGs done nationwide and the demo hospital had .2 percent of the national market, it would be "importing" another 300 patients (most likely from other nearby markets).

The absolute change in the volume of demo patients between one year and the next can then be written (approximately) as:

$$WD_{dt} = D_{mt}*[WD_{mt} + WDSH_{mt}] + D_{nmt}*[WD_{nmt} + WDSH_{nmt}] \quad (2)$$

ln words, the growth in total demo CABGs depends upon the growth in the total demo market (WD_{mt}) and the outside market (WD_{nmt}) plus the growth in the local and nonlocal market shares enjoyed by the demo, weighted by the absolute size of the two markets to begin with.

Using these formulas, we will rely upon HCFA's Part A MedPAR file of all hospital discharges to, first, estimate the base period, 1990, values for each of the four parameters of the demo's volume equation (1). Then, as MedPAR is updated periodically, we will re-estimate the parameters and calculate the four internal and external market growth rates according to equation (2). Demo CABG volume increases can then be separated into four components:

- that due to internal market growth;
- that due to external market growth;
- that due to an increase in internal market share; and
- that due to an increase in external market share.

Comparison of these rates will allow us to determine whether demo volume growth is the result of the secular growth in CABG surgery nationwide, in the local market, or an enhanced competitive advantage.

4.1.2 Definition of the Local CABG Market

A technical issue concerns the definition of the local CABG market. All of the demo hospitals draw from a multicounty, urban, and rural population and compete in some sense with a large number of hospitals. Consequently, we will not constrain ourselves to the MSA but, rather, will determine from MedPAR data all the hospitals in Massachusetts, Georgia, Ohio, and Michigan performing CABG surgery. We will then review this list with each hospital, asking the staff to identify hospitals as "close" and "distant" competitors. The set of close competitors, regardless of geographic proximity, will constitute our definition of the "local

market." Sometimes, as in Ann Arbor (St. Joseph's, Catherine McCauley), more distant Detroit hospitals (e.g., Henry Ford and Baumont) are considered closer competitors than more geographically proximate institutions, (e.g., University of Michigan). To avoid arbitrary geographic boundaries of the market or the omission of a local competitor, we will include all CABG hospitals within the MSA in our definition.

4.1.3 HCFA Part A Data

To support this analysis, we request that HCFA's data center maintain a MedPAR Part A national database on all discharges from DRGs 106, 107, and 108 (although DRG 108 is not under the demonstration, some CABGs will be coded into this DRG, and we need to track this volume as well). All ICD9 codes for PTCA should also be tracked since the volume of PTCA's may have an impact on CABG volume. This subfile could be updated annually at a time mutually convenient to HCFA and us. The file should include roughly 125,000-175,000 cases annually. Once the evaluator received the file, we would identify all hospitals in the predetermined local markets and produce tables showing the quarterly growth in CABG volume for each of the demo hospitals, the rest of the local market, and nationally outside the local market.

4.1.4 Case Study Interviews on Local Market Competition

Gross numbers as accumulated in 4.1.3 may, by themselves, be misleading. For this reason, we will conduct in-depth interviews with both demo and non-demo local CABG hospitals to see what effects administrators believe the demo is having. We will also attempt to corroborate the changing volumes with the demo hospital's marketing efforts. The kinds of questions we would ask as part of our on-site case studies would include the following: How important was local competition and the threat of competing against another PHBC in the demo site's decision to apply? In retrospect was that concern well founded? Have other CABG hospitals competed with the demo site in any way? Have they increased their own

marketing? Have they made other linkages with hospitals or referring physicians? Do demo and non-demo sites see CABG surgery as a zero-sum game or can everyone benefit from broadly targeted marketing? Most importantly, did the demo site have an overall strategy regarding volume? How did this translate into a marketing effort? Did the demo site even want to increase volume, or did it simply apply as a Center to avoid losing market share? (This is an important question because it can help explain the aggressivity with which demo sites pursue new patients.)

As part of our case studies, we also intend to interview administrators of 2-3 close competitors in each site. Our emphasis will be on the nature of patient competition, how competitors have reacted to the designation of another hospital as a Heart Bypass Center, etc. Special attention will be given to any gains or losses in market share by competitors and the reasons for the change, e.g., loss of thoracic surgeon, loss of referrals to Heart Bypass Center.

4.2 Net Program Savings to Medicare

Once we have generated estimates of demo and non-demo market shares, we will be able to estimate net program savings. The basic evaluation question is: What would the program have paid out in lieu of the negotiated bundled inpatient payment at each site? The first step involves a direct comparison of pre- and post-demo global inpatient payments at each demo site. This would include any beneficiary out-of-pocket payments, since HCFA is interested in the incidence of any gains. Do they accrue primarily to the patient in lower deductibles, copays, and foregone balance billing, or does the program also share significantly in negotiating a much lower total price? It is these savings that comprised the OMB waiver cost estimates. Under the terms of the demonstration, they must be less than what the program would have paid out under prospective payment. The only technical issue concerns the allocation of capital and direct medical education. So long as any capital and DME payments under the demo are subtracted from Medicare's total passthrough amounts, the allocation scheme is

immaterial. However, if HCFA fails to treat the passthrough amounts included in the global bid correctly at reconciliation, overpayments could occur.

The far more difficult task is to answer the next cost question: Did the program save money after considering volume shifts from non-demo to demo hospitals? This question reflects a basic concern over initial demo selection bias. If HCFA, because of its rigid quality and volume criteria, accepted only high-cost CABG hospitals, it is likely that any volume shifts will raise total outlays status quo ante, unless negotiated price reductions were substantial. Whether this should be counted against the demo is a philosophical question related to the issue of external validity of the cost findings. That is to say, high-cost selection bias in this small demo may not be nearly as severe once a large number of CABG hospitals are in the program. In any event, it is a useful exercise to estimate the extent of any perverse cost increase due to changing market shares, if only to have an estimate of the dimension of the problem.

During the selection process, all candidates' bids were screened against the costs of other local hospitals performing CABG. It is our understanding that all four demo hospitals are low-cost in their own market area. Hence, any bias due to changing market shares may, in fact, overstate the gains HCFA could expect from a national program that could select more expensive hospitals in some cities. Additional costs outside the global rate could also result in higher costs than projected under the waiver cost estimates.

In considering the issue, we suggest three measures of net program costs, each somewhat broader than the previous one. The first, and narrowest, measure would simply involve net inpatient program savings at the demo hospitals:

4.2.1 Inpatient-only Savings Definition:

$$NS^{1}_{dt} = [NIPC_{dt} - P^{*}_{dt}]*D_{dt} \qquad (3)$$

$$NIPC_{dt} = DRG_{dt} + OUT_{dt} + PT_{dt} + S\ P_{dm}MD_{dmt} \qquad (4)$$
$$m$$

where NS^{1}_{dt} = net program savings in the demo hospital in year t under the narrowest definition of gains; $NIPC_{dt}$ = the expected net inpatient program (including beneficiary) outlays per discharge in the d-th demo hospital in year t in lieu of the demonstration; P^{*}_{dt} = the negotiated price in year t; D_{dt} = the total number of CABG patients in the demo hospital in year t; DRG_{dt} = expected DRG 106 or 107 payment to the demo in lieu of the bundled payment; OUT_{dt} = average CABG outlier payments; PT_{dt} = average Part A passthroughs; P_{dmt} = average physician allowables for the m-th service; and MD_{dmt} = average quantity of inpatient physician services per CABG discharge in the demo. Only Part A DRG, outlier, IME, and pass-through costs plus Part B inpatient physician costs would be counted. One version would include beneficiary obligations while another would focus strictly on government obligations. Under the narrow definition, estimated program gain or loss would depend strictly on whether the bundled negotiated price was below or above expected outlays under prospective payment. The figures in brackets would be on a per discharge basis so as not to confound gains with any volume changes. A total savings would involve multiplying per case savings by total demo Medicare CABG volume. Any productivity gains due to volume increases would not accrue to the program unless HCFA negotiated a sliding volume rate. Inflation would not be a problem because expected outlays in lieu of the demonstration (NIPC) would be evaluated over the same prospective period covered by the negotiated rate. Also note that NIPC is not actual hospital costs per case but an estimate of yearly Medicare payments under the existing DRG system.

Discharges by DRG will come from HCFA's new 100 percent Part A and B data system. Net inpatient outlays to the demo hospital in lieu of the demo can be calculated two ways.

First, base period, 1990, average Part A and B payments can be rended forward by the allowable PPS update factor and the corresponding update on Part B. Alternatively, the actual submitted bills by demo sites could be used instead. The advantage of the latter is that they should be a very accurate indicator of what HCFA would have been liable for in each year of the demo, including outlier, capital, and physician services that are demo-specific. Both approaches require a year of baseline Part A and B data and accurate update factors, which we expect HCFA to provide.

4.2.2 Inpatient-plus-Outpatient Savings Definitions

A broader definition of net Medicare savings (or costs) would consider outpatient and other institutional costs as well. Hospitals, and particularly physicians, will have greater incentives to discharge earlier with attendant follow-up care at home or in another hospital, with additional bills submitted outside the demo. This broader measure is defined as follows:

$$NS^2_{dt} = NS_{dt} + (NOPC_{do} - NOPC_{dt})*D_{dt} \qquad (5)$$

$$NOPC_{dt} = NIPC_{dot} + OPD_{dt} + SNF_{dt} + SP_{dot}MD_{dot} + DME_{dt} + HHA_{dt} \qquad (6)$$

where NS^2_{dt} = net savings including the difference between pre-demo and post-demo costs not covered by the negotiated price (i.e., $NOPC_{do}$ minus $NOPC_{dt}$); $NIPC_{dot}$ = net inpatient program outlays at other hospitals for CABG patients operated on at the demo site then transferred; OPD_{dt} = total Part A outpatient costs per CABG discharge; SNF_{dt} = per CABG discharge SNF costs; $SP_{dot}MD_{dot}$ = total outpatient physician costs; DME_{dt} = average durable medical equipment costs per CABG discharge; and HHA_{dt} = average home health costs. Where HCFA's negotiated price for inpatient care plus the average Part A and B non-demo costs related to the surgery exceeds what the program would have paid in total, the program would actually lose money. This could be true even if the negotiated price with the demo site

was below previous inpatient demo costs if the outpatient shift elasticity was large enough, i.e., if the second term of NS^2_{dt} in parentheses was quite negative.

4.2.3 Shifting Market Share Savings Definition

The broadest measure of cost savings would include the first two measures and go a step further by including any additional savings or losses that result from changes in the locus of surgery:

$$NS^3_{dt} = NS^2_{dt} + [W(1\text{-}MS_{dt})*NIPC^*_{ot} + WMS_{dt}*P_{dt}]*D_{dt}$$

where NS^3_{dt} = net total savings including adjustments for both ambulatory cost (NS^2_k) differences and any differences due to shifts to a more or less expensive demo center; WMS_{dt} = change in the demo's market share; and $NIPC_{ot}$ = average net inpatient CABG costs in local non-demo hospitals. The term in brackets can be interpreted as the change in the average net cost per CABG discharge in the demo market area after accounting for shifts away from competitor hospitals towards the demo hospital plus any negotiated reductions in demo site Part A and B payments (including outpatient services). Note that if no volume shifts are found, the bracketed term vanishes and the net program savings are equal to NS^2_{dt}.

4.2.4 Quantifying Medicare Savings

Quantifying the various program cost estimates is no simple task, although the Part A inpatient program outlays for the demo sites should be straightforward. From the hospitals (or HCFA) we can determine their Medicare PPS standardized amounts adjusted by the wage index. We will then multiply these estimates by the current DRG 106 and 107 charge weights to derive a basic PPS payment in lieu of a negotiated price. Then we will develop a pass-through adjustment factor that includes capital payments, Direct and Indirect Medical

Education, etc. Outlier payments would be determined based on the actual claims from the demo hospitals using CABG length of stay and cost thresholds and allowable program outlier per diems. Any CABG patient deductibles and copays that would have been owed if the demo had not been in place will also be determined from Part A claims.

Part A costs are more problematic for the other local and dispersed non-demo sites. This will require using the MedPAR CABG discharge data for the predetermined set of "competing" CABG hospitals. It also involves merging Medicare Cost Report data that includes data such as outliers, direct medical education and capital costs onto the file. This can probably be taken from HCFA's Impact File. Given the relatively small number of "competing" non-demo sites identified by the Centers, we could acquire the most recent cost reports from the Fiscal Intermediary and abstract the few relevant items. The MedPAR claims files would also give us the outlier days on each non-demo patient in the "competing" group, which we can convert to payments using the PPS outlier payment formulas.

4.3 Impact of Volume Changes on Average CABG Costs: Micro-costing of CABG Surgery

The third evaluation area related to cost and volume concerns the impact of CABG volume changes on average costs per case. If the demonstration hospital, by being a Heart Bypass Center, can attract more patients, and if more patients can substantially reduce average costs, then greater profits are possible--even under a single, discounted rate. This could also be an important "selling point" to future applicants. If, on the other hand, average costs are insensitive to volume, then little is gained from becoming a center--at least from the hospital's perspective.

4.3.1 Cost Theory

Average total costs can be decomposed into average fixed costs and average variable costs, while marginal costs are defined as the change in variable costs from a one unit change in volume. For small CABG volumes, fixed costs, will be relatively high and variable costs relatively low, as will be marginal costs. In a low-volume regime, the hospital would likely be experiencing strong returns to scale and declining average total costs. Average fixed costs are always declining with increasing volume. Thus, if marginal costs are below average costs, then average total costs must also be declining. Even if marginal costs are rising, average costs could still be falling if the weighted decline in average fixed costs exceeds the weighted increase in marginal costs.

A few hypotheses follow directly from this simple cost theory. First, if CABG costs are primarily fixed, then average total costs are likely to be declining over a significant range of volume. Alternatively, if most CABG costs are variable, then it is likely that marginal costs are close to average costs with few scale economies.

4.3.2 Measuring Fixed and Variable Costs

The goal of this task is to determine the fixed and variable costs of CABG production in order to ascertain whether demo hospitals are benefiting from scale economies. With the help of demo staff and their costing systems, we propose to conduct a micro-costing of CABG surgery covering the entire inpatient stay. In our original proposal (p. 2-49) we were going to select 20-30 patient bills per hospital to identify the use of specific supplies, drugs, and other nonlabor items. We were also going to distinguish fixed vs. variable nursing inputs. As part of our initial site visits in March and April, 1991, we have determined that all four sites have extensive cost reporting systems that allow administration to track itemized costs at the patient, DRG, and physician level:

- St. Joseph's (Atlanta): HBO Product Accounting System;

- St. Joseph's (Ann Arbor): COMPASS;
- University (Boston): Transition Systems; and
- Ohio State (Columbus): Query Management System.

While each costing system is unique, all are designed to measure costs at a very micro level, i.e., usually the individual procedure. They all make a concerted attempt to measure real, direct, resource values, or RVUs. Atlanta's HBO system is particularly ambitious in developing detailed resource inputs at the procedure level using industrial engineering techniques. Boston is now implementing a very similar system. Each of these systems appears adequate, with certain enhancements, to carry out the micro-costing we had intended to do on our own.

As part of our data collection protocol, we will specify the data requirements for this micro-costing for each site. The first task will be to pull off their systems all bills and services for every patient undergoing CABG surgery, first, for 1990 as a base year, and then for the subsequent 3 years of the demonstration. We will then have the sites aggregate these items into broader cost areas--probably 20 or so (e.g., operating room, ICU, lab, radiology, respiratory therapy) and sum the estimated costs for each patient by cost center. Costs of each item are generally separated into direct and indirect--both of which can fall with greater volume, e.g., less nursing time per ICU patient with higher occupancy.

4.3.3 Costing Refinements

In completing the micro-costing, we are also planning several enhancements to the basic hospital data. First, we will request the hospital to collect all physician (and perfusionist, etc.) bills, which we will add to various cost centers (e.g., surgeon and perfusionist time to the OR).

Second, we will attempt to refine operating room costs to better reflect CABG-specific costs. After our interviews with the OR nurses during the site visits, we were impressed with the itemized billing detail. St. Joseph's, Ann Arbor, is typically charging the OR in half-hour increments according to several schedules depending upon the labor intensity of the operation. In addition, they have separate group supplies and itemized supplies specific to the CABG surgery, plus a clean-up charge. Finally, all blood products, anesthesia costs, perfusion costs, etc. are billed separately as well. All that is required is for us to apply cost-to-charge ratios for these items to arrive at costs.

Third, nursing services constitute a significant part of each bill. (One patient had a bill of $24,388, of which $2,500 was for the ICU and another $1,800 in general nursing.) Each site bills differential rates in their ICUs, intermediate, and routine nursing floors. The rates, however, are based on average per diems in each unit. To the extent CABG patients require more (or less) nursing services in each unit, the per diems fail to capture this. To supplement the per diem costs, we propose to have each site collect and aggregate patient acuity data for their CABG and non-CABG patients on each floor for 2-3 months. These acuity systems track nursing requirements by patient, allowing us to determine how more (or less) intensive CABG patients are in terms of nursing services. We will then adjust the per diem costs in each unit to arrive at the CABG-specific per diem, PD(CABG), i.e.,

$$PD(CABG) = \frac{\text{OVERALL UNIT PER DIEM NURSING COST}}{A + (1 - A)*B}$$

where A = share of CABG in total days per period in the unit, and B = ratio of the non-CABG to the CABG per diem cost, determined from the acuity data.

4.3.4 Micro-Cost Analyses

Once all the data have been collected and processed, several analyses are proposed. First, we will provide a set of distributional tables showing the variation in CABG costs by patient in each site. Special attention will be given to the variation in the 20-or so cost centers. These tables will show, for example, how much of the cost variation is due to longer stays and how much to extra pharmacy usage. Our special patient acuity studies will allow us to present tables showing systematic variation in nursing services for CABG vs. other patients, first, within the ICU and, second, for routine nursing.

Next, we will pool the cases for each site and use t-tests to determine any significant cost differences across sites, treating DRG 106 and 107 separately. Where possible, we will also statistically compare real input differences (e.g., days in the ICU, days in routine nursing, average operating room time).

Third, within each site, cases will be stratified according to CABG volume per year then statistical tests performed again to test for any volume effects. We will also pool all CABGs across sites and regress total cost per CABG on a set of patient characteristics, hospital characteristics, and the hospital CABG volume for the year in which the operation occurred. A negative volume coefficient would be interpreted as evidence for a declining volume effect on cost per CABG. We will also include two other volume-related variables to capture more general volume effects on indirect costs (i.e., total inpatient operations and total discharges). This will control for the possibility that, for example, operating room costs may fall because overall surgery volume rose and not because of the increase in CABG surgery specifically.

Finally, our micro-costing will allow us to isolate any sources of scale economies. Is it in the OR? The ICU? In radiology? Further, we will be able to display tables of costs divided into fixed vs. variable. The former should better reflect scale economies than the latter.

4.4 Cost of the Demonstration to the Participants

In addition to the costs of treating patients, participants also incur costs in administering the demonstration. These costs can be decomposed into two parts: (1) costs involved in the negotiation phase; and (2) costs involved in managing the demonstration over the three years. It is important to study these costs to determine the extent of the administrative burden on hospitals and physicians of receiving a single, bundled, payment. It is also important to separate treatment and routine administrative costs from costs specific to the demonstration so as not to overstate the former in study-control evaluations of efficiency.

No objective reporting system currently picks up administrative costs. We will need to develop our own costing instruments. For, the initial bidding process, we will develop a retrospective data collection protocol that relies on staff recall. Working with the principal contact in each demo site, we will identify all staff involved in preparing the initial bid and subsequent negotiations. From these, we will develop a list of functional tasks: hospital costing of CABG surgery; physician costing of CABG surgery; coordination of internal hospital-physician payment arrangements; writing the HCFA proposal; developing patient outcome measures; developing a marketing plan, etc. After finalizing the protocol in consultation with each site, we will mail the protocol to each site to be filled out by the appropriate staff.

We propose a similar process for monitoring the on-going administrative costs. First, in consultation with demo staff, we will identify major demo administrative tasks: hospital billing to HCFA, physician billing unique to demo, hospital cost reporting specific to demo, physician patient appropriateness and outcomes monitoring specific to demo, and demo-specific marketing. Each site will then be asked in the protocol to identify all staff involved in each task, including the CEO, CFO, etc., and to monitor hours spent per month per task. The evaluator will supply each site with data collection forms that they can use to record the information.

Once these data are supplied by each demo site, the hours will be aggregated by substantive task and displayed in tables showing site-specific detail as well as overall averages (e.g., average person-hours involved in preparing the financial estimates related to the bid). Because of the diversity in training of staff, simply summing hours and comparing across tasks can be misleading in terms of the value, or true cost, of the task. Our solution is to weight reported hours by average hourly wages by occupation, which will also be collected at a point in time as part of the data collection protocol. Because physicians do not receive an hourly wage, we will use an imputed wage based on the most recent PPCIS survey funded by HCFA. Imputed wages will be decomposed by specialty. For example, assume that the monthly invoices sent to HCFA involved the following administrative times: hospital accounting and billing, 10 hours; physician administrators, 20 hours; cardiologists, 2 hours; and thoracic surgeons, 2 hours. If the average hourly salary of each group is $15, $14, $100, and $150, then total monthly cost for administrative billing at the site would be $930. While the hours will be monitored concurrently during the demo period, we will collect salary information only near the end of the three years. All hours will be weighted by these end-period wage rates, putting costs into the most current terms as of the end of the demonstration.

4.5 Organizational Response to a Single Payment

Besides the quantitative analyses of hospital costs and volumes, the evaluator also proposes to conduct detailed on-site case studies of several organizational aspects related to the single payment. The purpose of these case studies is to describe the organizational changes that are behind the numbers on costs and volumes appearing in the final report. If demo sites have become more efficient, we want to describe how this has occurred. We also want to analyze physician responses to a single payment that may explain positive or negative outcomes.

4.5.1 Bundled Physician Payments

Certainly the most novel aspect of the demonstration is the inclusion of most inpatient physician services in the single bundled payment made to the hospital. Many hospitals were not able to put together a physician team to submit a bid, no doubt due to the reticence of physicians to divide a fixed amount on each case. The first step in this part of the evaluation will be to conduct detailed discussions with hospital staff and physicians on the internal negotiations regarding how much each specialty and physician would be paid under the demo. Were physicians essentially given a mandate or was there considerable debate? Were all physicians consulted or primarily the thoracic surgeons? Why did anesthesiologists agree to participate? Did they have a real choice?

The next step involves describing the nature of the internal payment arrangements. How much of the global payment goes to the hospital versus physicians? Based on our initial site visits, it was clear that this division was determined as part of the "actuarial" task of determining current costs. If the physicians reported receiving $5,000 per case, then they argued that this should be their average payment from the hospital--at least before any agreed-upon discounts. Hence, the data base and initial negotiations are critical to understanding the level of the payment split.

Of more interest is the structure of the physician payment. Does it vary at all by case and, if so, how? How are outliers paid? Within groups, are physicians paid based on CABG volume within the demo? Are there any arrangements across the hospital and physicians to share in gains or losses? If so, how are they measured? If not, why not? Are there any incentives for physicians to use fewer physician or hospital resources? Are there holdbacks for unexpected costs? Are there special pools for other physicians not included in the demo?

Our initial site visits revealed a simplistic approach to physician payment at most sites.

That is, each physician participating in the demo (usually the four major specialties of surgery, cardiology, anesthesiology, and radiology) will receive a fixed payment over the duration of the experiment, ceteris paribus. This may change over time as payments are made and both groups respond to incentives to become more efficient.

4.5.2 Cost Management

A key incentive in a single bundled payment is to improve managerial and clinical efficiency. The former pertains to the way in which the hospital organizes and manages its various services and departments such as the operating room. Clinical efficiency pertains to the way physicians manage individual CABG cases to control utilization and will be addressed in Section 5 of the design. This section outlines our plans for evaluating cost management at the hospital level.

Over the course of the experiment, the evaluator will collect extensive micro-cost data from each demo site. We also plan to supplement these data with detailed interviews with key hospital staff responsible for managing CABG services. These would include, besides the CEO and CFO, the various directors of key services: nursing, intensive care, operating room, radiology, catheterization lab, etc. In some sites, the list would also include directors of the "Heart Institutes", VPs for patient services, utilization review, etc. These interviews would be targeted at CABG patients and the ways in which their diagnosis and treatment has changed since the demo started. They would also address productivity improvements within each department. For example, four levels of nursing care are possible for each patient after surgery: recovery, SICU, progressive observation, and routine nursing prior to discharge. Avoiding recovery and going directly to the SICU could save money. Also transferring patients quickly from the SICU to the progressive care monitoring unit could also save on nursing.

Besides labor, purchasing lower cost supplies and drugs can also reduce costs. Hence, we will interview heads of central supply, purchasing, and the pharmacy.

Finally, a special case study analysis will focus on the operating room where a large percentage of a patient's costs will be incurred. How many people are on the team? What is the role of anesthesiologists vs. nurse anesthetists? What do residents do that saves surgeon time? How long is the surgery? What is done to shorten OR times?

Another important cost issue is the impact of greater volume on costs. Our micro-cost data will allow us to calculate costs per case, but we still need to go behind the numbers to understand the scale-cost relationship. For example, if the CABG volume has increased, how has this affected average utilization rates of the OR, the SICU, the cath lab, and routine nursing? What expansion decisions were made in response to growing volume? How has management of these units changed, if at all, under growing volume pressure?

5.0 QUALITY OF CARE

This section presents an overview of the study's objectives, review the methods to determine appropriateness of CABG and PTCA, present the methodology to measure outcomes and quality management systems, and review the goals for subsequent site visits.

5.1 Overview

A major objective of the study is to evaluate the appropriateness and outcomes of care for CABG recipients in the Medicare Heart Bypass Center demonstration sites and to compare results in these centers to those achieved by non-demonstration sites in the same market areas. Time series comparisons within sites and cross-sectional comparisons among demonstration sites and between demonstration and non-demonstration sites will be performed. Evaluation of demonstration sites will rely on a combination of data sources including: cardiac and cardiac surgical registries; medical record reviews; hospital management information and quality

management systems; surveys of samples of CABG recipients; interviews with key medical staff conducted during site visits, and Medicare Parts A and B claims data analyses. Comparisons with nondemonstration sites will depend on medical record reviews of sampled patients, if resources permit, or Medicare claims alone, if they do not.

These are two hypotheses that we plan to test:

- **Hypothesis 1:** The appropriateness and clinical outcomes of CABG either will not change or will improve in demonstration sites over the period of the demonstration, and
- **Hypothesis 2:** Performance will be as good or better in the demonstration sites than in competing hospitals in the same market areas.

Evaluation of the hypotheses will focus on the following:

- **Appropriateness:** Assessment of appropriateness will rely on the "appropriateness model" that was developed using a two-stage modified delphi process by HCFA's expert Technical Advisory Panel (report to HCFA dated May,1991). Clinical indications will be examined for both CABG and PTCA because of the increasing substitution of PTCA for CABG.

- **Outcomes**: Outcome assessment will be multidimentional. The primary outcome measure will be case-mix adjusted mortality at 30, 90, 180 days and one year following surgery. Other outcome measures will include:

  -- in-hospital complications attributable to CABG;

  -- post-discharge complications and readmissions;

  -- functional status and quality of life; and

-- patient perceptions of the quality of care received.

The latter two outcomes will be available only in CABG patients treated in the demonstration sites.

5.2 Appropriateness of CABG and PTCA

The appropriateness of CABG and PTCA procedures will be examined in the demonstration sites during a baseline year and annually thereafter using an "appropriateness model" referenced above. This model provides both a matrix for describing the clinical characteristics of patient populations that receive CABG or PTCA and the basis for calculating appropriateness scores for cardiac surgery and angioplasty programs as a whole. The data that are required will be obtained from cardiac and cardiac surgery registries after validation of these data sources by medical record reviews performed during the baseline period.

Ideally, case-mix and appropriateness of CABG and PTCA in competing hospitals will be evaluated using the same model and data obtained from medical record abstractions performed by the local PROs. Resources over and above those requested in the current budget will be required for this purpose. To reduce costs, medical record abstractions would be restricted to CABG and PTCA patients who receive their procedures during the baseline Year (1990) and Year 3 of the demonstration, and would be performed on random samples of 100 patients undergoing each type of procedure in the demonstration site's major competing hospital(s) during each time period.

If additional resources are not available, comparisions will have to depend on PRO precertification data and Medicare Part A and B claims data. Limitations of the PRO database relate to variations in the clinical criteria used by the various PROs and widely

varying content of resulting databases. Medicare claims data, on the other hand, can provide information on the volumes and types of procedures performed and some information on patient characteristics (age, sex, race, comorbidities) but cannot provide the information needed to classify the severity of underlying coronary artery disease. In using Medicare data only, general statements can be made with respect to comparisons of appropriateness between demonstration and nondemonstration sites.

5.2.1 Data Elements

The data elements required for the "appropriateness model" are the following:

Treatment Variables:

Type of procedure (CABG, PTCA, both);

Characteristics of procedures (number and types of bypasses or dilations);

Concurrent valve surgery; and

Other procedures.

Patient Characteristics:

Clinical subgroup of patient;

Location and extent of coronary artery disease including percent stenosis of each diseased vessel;
Suitability of vascular lesions for PTCA;

Procedure status: elective, urgent, emergent;

Left ventricular ejection fraction;

Severity of angina;

Preprocedure treatment for angina;

Use of thrombolytic agents (in patients with AMI);

Presence of preoperative cardiogenic shock;

Pre-operative use of IABP;

Exercise tolerance results; and

Comorbidities: age, sex, obesity, reoperation, diabetes, hypertension, dialysis dependency, COPD on medications, peripheral vascular disease, symptomatic carotid artery disease, etc.

An explicit protocol will be designed to guide medical record or cardiac registry abstractions.

One of the major challenges to valid assessment of appropriateness lies in the assessment of the degree of disease of affected coronary arteries. Methods for assessing stenosis vary widely among hospitals, ranging from subjective "eyeball" measurements to the use of calipers or sophisticated computerized "edge" techniques. Since the degree of stenosis is such a critical determinant of the need for CABG or PTCA, we propose that a validation study be performed in the demonstration sites. Five percent random samples of the coronary angiograms of PTCA and CABG patients would be independently reviewed by observers in two hospitals using a caliper technique. Instances of major disagreements would be reviewed by a third reviewer. Results of comparisons between the initial "clinical" interpretations of the angiograms and reviewers' interpretations would be returned to the hospitals (confidentially, if desired by the hospital). This study would be repeated annually, with changes in discrepency rates tracked over time. We will need to explore with the sites whether they will agree to perform this study without additional resources. The modest degree of effort required by any one site, plus the interest expressed in its results during initial site visits, suggests that they may not request additional funding.

5.3 Outcomes

Outcome assessment requires both accurate measurement of the outcome in question and adjustment for differences in patient characteristics (case mix) that may affect each outcome. A uniform clinical database is proposed for the demonstration sites that will permit measurement of multiple outcomes and case-mix adjustment of outcomes for CABG patients. The comparisons that will be made between demonstration and non-demonstration sites will, as in the case of appropriateness, depend on whether resources can be obtained for medical record abstractions of samples of CABG patients in the latter.

5.3.1 Outcomes to be Measured

The following outcomes will be measured on all CABG recipients.

1. Mortality 30, 90, and 180 days and one year after CABG surgery.
2. Readmissions to the same or different hospitals within 90 days of hospital discharge.
3. In-hospital complications.
4. Hospital length of stay and SICU length of stay.
5. Post-discharge complications that compromise function but do not require hospital admission.
6. Functional status and quality of life 30 days and one year after CABG surgery.
7. Patient perceptions of the quality of the hospital care received.

5.3.2 Uniform Clinical Database

Valid comparisons among demonstrations sites will be greatly facilitated by a database that contains the same data elements and uses the same definitions for each element.

Demonstration sites will be asked to maintain such a database on all CABG patients who are enrolled in the demonstration. Most data will be available from the hospitals' cardiac surgery registry. To the extent necessary, they will be supplemented by information from the hospitals' management information system and medical records.

Data elements will be specified in a manner similar to the National Cardiac Surgery Database. Two demonstration sites (St. Joseph's Mercy (Catherine McCauley) in Ann Arbor and University Hospital in Boston) already use this system (NCSD), and the registries at Ohio State Hospital and St. Joseph's in Atlanta have many variables in common with it.

Information on the post-discharge clinical course of the patient will be collected during follow-up visits and/or by administration of telephone or mailed questionnaires one and twelve months after discharge. Assessment of functional status and patient satisfaction will be included. The starting point for assessing health status will be a Health Status Questionnaire (SF-36) developed by John Ware, Ph.D., and that for assessing patient satisfaction will be a survey instrument developed by the GHAA (Group Health Association of America). Ideally, demonstration sites will agree to collect the post-discharge data on all CABG recipients. If not, selected questions will be included in the survey of a sample of patients described in Section 6.

The data elements to be included in the uniform clinical database are listed below. Data collection protocols based on these variables will be developed in collaboration with the staffs of the demonstration sites.

Information on Hospitalization:

Hospital name.

Name of principal surgeon for CABG.

Date of initial referral to hospital for cardiac evaluation or CABG.

Dates of admission and discharge for coronary angiography (if separate admission).

Dates of any other invasive cardiac diagnostic or treatment procedures performed during the CABG admission (e.g., cardiac cath, coronary angiography, PTCA, or as a result of complications.
Number of days in the SICU.

Sociodemographic Data:

Name.

Social Security Number.

Home Address.

Birth Date.

Sex.

Race.

Name and address of referring physician.

Employment status preoperatively.

Clinical History:

Cardiac history.

Prior Myocardial Infarction (MI) and date(s).

New York Heart Association (NYHA) functional class at time of admission.

Prior CABG (date and results).

Medication regimen at time of admission.

Primary "indication" for CABG.

Risk Factors:

Smoking history (type, duration, and current amount or stop date).

Serum cholesterol.

Body mass index (or weight and height).

Comorbidities:

COPD ($_pO_2$, FEV, medications).

Chronic renal disease (serum creatinine; whether on dialysis).

Previous stroke or TIA.

Peripheral vascular disease.

Cardiac Catheterization/Coronary Angiography Data:

LV ejection fraction and how it was measured.

Degree of stenosis of the left main, LAD, circumflex, right coronary arteries, and any important marginals.

Aortic and peripheral arterial blood pressures.

Complications of coronary angiography (if applicable).

Complications of PTCA (if applicable).

Pre-operative Risk Assessment:

Surgeon's preoperative assessment of probability of operative mortality.

The use of anti-coagulants, preoperatively .

ASA classification.

Priority for surgery (elective, urgent, emergent).

Use of IABP (Intra-aortic balloon pump) preoperatively.

Operative Data:

Numbers and types of bypass grafts (saphenous vein or internal mamary artery).

Concurrent procedures (endarterectomy, angioplasty, valve repair or replacement, aneurysmectomy).

Duration of procedures (anesthesia time, pump time, skin-to-skin time).

Support devices used (IABP, CPS).
Anesthesia (agents used and any complications).

Intra- and post-operative blood replacement.

Perioperative (30 day) complications.

Death (date and location within hospital if a hospital death).

Perioperative MI (new Q waves).

Postoperative cardiac arrest.

Post-op use of IABP (inclusive dates).

Time on ventilator, if greater than 24 hours.

Postoperative stroke or TIA.

Renal failure requiring dialysis.

Mediastinitis.

Pneumonia.

Wound infection.

Reparation for bleeding.

Repeat cardiopulmonary bypass on same admission.

Status at the time of Hospital Discharge:

Stability at time of discharge (Blood Pressure, Respiration, Temperature).

Functional status at time of discharge (activities of daily living, angina level).

Medications at time of discharge.

Discharge destination (home, nursing home, etc).

Post-Discharge Clinical Outcome:

Survival to one year (date and cause of death, if applicable).

Readmissions to a hospital within 90 days (reasons, relationship to CABG).

Repeat cardiac procedures (PTCA, CABG) within one year.

At 1 and 12 months:

Functional status compared to preoperative level.

Angina (NYHA classification), including description of unstable angina, if applicable.

Medications.

Return to work (date) and level of productivity compared to preoperatively.

Change in risk behaviors (smoking, diet weight).

Patient satisfaction with hospital care.

Post-discharge care patterns - including evidence of gaps in care or change in primary provider.

Note: Data collection protocols will be developed in collaboration with the staffs of the demonstration sites.

5.3.3 Comparisions of Demonstrationand Non-Demonstration Sites

Comparisons will be limited to mortality, in-hospital complications, and post-CABG

readmissions. Mortality and readmissions can be assessed by use of Medicare claims data, and secondary diagnoses on Part A (hospital) claims can provide some information on complications. Limitations of claims data relate primarily to the reliability of case-mix adjustment. Medical record abstractions will be required to obtain critical information on the severity of the underlying cardiovascular disease and associated with comorbidities.

5.3.4 Analysis of Outcomes

Cross-sectional comparisons and time-trends will be analyzed. Demonstration sites will be compared to each other at baseline and annually thereafter, while comparisons between demonstration and non-demonstration sites will be limited to the baseline year (1990) and Year 3.

First, descriptive statistics will be prepared for each outcome measure. Then, bivariate analyses will assess relationships between case-mix variables and clinical outcomes. Finally, multiple logistic or multiple linear regressions will be used to adjust for patient characteristics that can be shown to have statistically significant relationships to each outcome measure. Case-mix adjusted outcomes will focus primarily on mortality, length of hospital stay, readmissions, and post-operating functional status.

5.4 Quality Management Systems (QMS)

All four demonstration sites have active quality management programs. These programs vary widely, however, in their organization, quality indicators they monitor, and the manner in which data that are collected are used to influence the quality of patient care. Of most interest will be the effects of these programs on the appropriateness of CABG and PTCA, the length of hospital stay, and outcomes for CABG patients. QMS programs will be characterized at baseline and annually according to answers to the following questions:

(1) Admission Appropriateness: Are preadmission reviews performed? Are these formal (e.g. catheterization conference) or informal? Do preadmission reviews consider all potential candidates for CABG or only selected cases? Who is involved in the decision to offer CABG surgery (cardiologist performing the coronary angiogram only, cardiologist plus surgeon, surgeon only, referring physician)? Is admission appropriateness monitored continuously? If it is, how are results used?

(2) Length of Stay Appropriateness: Are overall LOS and SICU lengths of stay for CABG patients monitored continuously? Are these reviews performed prospectively or retrospectively? Are data displayed for individual surgeons or only for the program as a whole? Are reasons for long LOS or adverse trends in LOS examined? Have any actions been take to reduce LOS either with respect to systems problems or behaviors of individual surgeons?

(3) Outcomes: Are outcomes of CABG surgery continuously monitored? Which ones? Are these outcomes displayed by individual surgeon or only for the program as a whole? Are these data adjusted for case-mix? How are these data used to improve outcomes?

The intensity of QMS activities in each of these areas will be quantified and used as an independent variable in assessing relationships to the relevant dependent variable.

5.5 Site Visits to Demonstration Sites

Site visits are planned midway through Year 2 of the demonstration and near the end of Year 3. The purposes of these visits will be to discuss any changes in case-mix, appropriateness scores, or outcomes that have occurred in the interim and to identify any changes in referral patterns, patient selection criteria, clinical staffs, or surgical protocols that may have been responsible. Changes in hospital systems that may have had an effect on cardiac surgery will also be explored. Among such changes would be new facilities or equipment, bed availability or staffing, and changes in utilization or quality management activities. Staff to be interviewed during these visits will include cardiac surgeons, nursing personnel from the operating room, SICU, and floors, area administrators, and QMS staff.

6.0 MARKETING

To increase volume at the sites, the hospitals will need to demonstrate discrete marketing efforts. Because a successful demonstration relies on positive public response, the marketing effort must determine the needs of the public and respond to those needs appropriately. Marketing strategies are likely to differ greatly across the demonstration sites, depending upon competition within the community, hospital occupancy rates, medical staff competition, and the hospitals marketing budgets as well as the staffing and experience of the marketing department. Only through a case study can HCFA assess how aggressive the hospitals' marketing efforts were, how the marketing plans were carried out, and what strategies were most effective. The marketing study requires the development of a methodology and work plan for the collection of data and the evaluation of various marketing strategies.

We will monitor the marketing activities of the demonstration sites to measure their success in promoting the demonstration and increasing CABG volume. This analysis, which will be conducted throughout the demonstration, will trace the experiences of the sites during the course of the evaluation and review and evaluate the reasons behind their varying levels of success. The relationship between specific marketing strategies and changes in hospital patient bases will also be assessed. The analysis will allow for reevaluation and readjustment in marketing activities throughout the course of the demonstration, if necessary. In addition, data collected from the Heart Bypass Demonstration can be used to aid in the development of marketing strategies in other demonstrations in the future.

An important component of the demonstration analysis will be a physician and patient telephone survey. This survey will collect information on beneficiary selection patterns and physician referral patterns as well as physician and patient satisfaction.

This section begins with a discussion of the four elements of marketing (Section 6.1). Section 6.2 discusses the marketing activities at the demonstration sites. Section 6.3 describes the marketing data that will be collected from the sites and the analysis that will be performed. Sections 6.4 and 6.5 discuss the patient/physician follow-up survey to be conducted and the analysis of the results.

6.1 Marketing Elements

The four elements of marketing are referred to as the four "Ps:" product, price, place, and promotion. All of these elements are crucial to the marketing effort.

- **Product.** The marketing product is the service developed by the hospital in response to consumer needs. Here CABG surgery is the product that will be offered to the consumer. The product will be "sold" as a package, including both hospital and physician services.

- **Price.** The price of a product includes the dollar value charged for the product, i.e. CABG surgery. In this instance, the price also includes those costs to the patient incurred by buying the product. These costs may include the cost of transportation to and from the hospital for both patient and family, the cost of time lost from work (again for both patient and family), the cost of hotel accommodations for family, etc. Under the demonstration, the package price may include these costs. The effects of pricing on the patient may be very important. Patients will be responsible only for deductibles and co-payments for Medi-gap insurance, but these payments may be waived for patients without Medi-gap who have been determined to be indigent or medically indigent.

- **Place.** In hospital marketing, place refers to the accessibility of services to the consumer, e.g. the hospital admitting office's hours of operation, the surgery schedule, the proximity of the hospital departments to one another, etc. Place also refers to the actual location of the hospital. If the sites intend to extend their service areas, they must be aware of the constraints imposed upon patients who travel long distances to undergo surgery. These patients incur greater costs due to increased travel, the

necessity for hotel accommodations for family members, etc.[1]

- **Promotion.** Promotion makes consumers aware of the product/service that is available to them. Promotion as an element of marketing has four objectives:

  -- to inform and educate consumers of the availability of the service,
  -- to remind present and former consumers of the continued existence of the service,
  -- to persuade potential consumers that the service is worth buying, and
  -- to inform the consumer of where and how to obtain the service.[2]

6.2 Marketing Activities of the Demonstration Sites

In effect, the marketing activities of the demonstration sites have been ongoing, for the development of the product, price, and place was the result of market research and analysis by the hospitals over the course of developing the application to participate in the demonstration. Having established the first three elements (although some adjustments may be made to these elements, if necessary; additional services may be included for the package price, certain hospital services may be made more accessible, etc.), the demonstration sites will now begin promotional efforts. The efforts will be focused on physicians and the general public. Because most potential CABG patients will be referred to the demonstration sites by physicians, the key to increased volume lies in reaching referring physicians (a "consumer" in this case) and informing them of the HCFA demonstration, the advantages it offers to their patients, and the high quality of services offered at each demonstration site. Public awareness is also important as many potential patients (both Medicare and non-Medicare) and other

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[1]Richard C. Ireland, "Marketing: A New Opportunity for Hospital Management." *Health Care Marketing: Issues and Trends*, ed. Philip D. Cooper (Rockville, MD: Aspen Systems Corporation, 1985).

[2]Jon G. Keith, "Marketing Health Care: What the Recent Literature is Telling Us," *Health Care Marketing: Issues and Trends*. ed. Philip D. Cooper (Rockville, MD: Aspen Systems Corporation, 1985).

payers may request referrals to the demonstration sites when they hear about the package pricing. The demonstration sites have developed extensive plans to market the demonstration to physicians and potential patients both within and beyond their traditional service areas.

The marketing plans of the four demonstration sites are very similar (indeed, the hospitals have already begun to communicate with one another to share ideas and information), although each site also has marketing strategies that are solely its own. The sites intend to target physician audiences via direct mail campaigns, advertisements in local, state, and regional medical journals, and physician exhibits, meetings, conferences, and symposia. Potential patients will be reached through the general media, as well as through senior-directed and health-related publications; direct mail campaigns to certain patient and interest groups; and lectures and slide shows. Brochures targeting physicians and patients will be developed and disseminated widely. The nature of these promotional activities and the emphasis both in terms of manpower and budgets vary considerably across sites.

6.3 Analysis of Marketing Data

Analysis of the marketing activities of the demo sites requires the development of a data base. We will identify the data elements required to analyze hospital marketing activities and then collect the information from the hospitals. We intend to collect this information prior to the start-up of the demonstration to establish a baseline for comparison. In addition, the hospitals will be required to submit data to us on a quarterly basis throughout the demonstration.

Changes at the sites over the course of the demonstration in physician referral patterns, patient origin, patient satisfaction, and sources of payment can be attributed, at least in part, to the success of the hospitals' marketing activities. In order to measure these changes, we will analyze data collected by site as well as merge across the four demonstration sites. The types

of data that will be required for the marketing analysis are described below.

- Referring Physicians
  - -- characteristics (privileges at the demonstration site, at other sites, age, and specialty)
  - -- number of patients referred by each physician (with age and the number of bypasses received)
- Patients
  - -- age and severity of illness (number of bypasses) of each patient
  - -- patient origin by zip code
  - -- source(s) of payment (Medicare, traditional indemnity insurance, HMO, PPO, Medi-gap, etc.)
  - -- use of services provided under the demonstration (e.g., transportation, family accommodations, etc.)
  - -- results of site patient satisfaction surveys

In addition, we will collect from each site the following qualitative information about their marketing activities:

- Patient services offered both before and after start-up of the demonstration
- The marketing budget for the demonstration as well as that used prior to demonstration start-up
- Marketing activities plan (updated when adjustments are made during the demonstration)
- Promotional materials developed by the sites for the demonstration
- Newspaper and journal articles resulting from the demonstration

By September 30, 1991, all sites will submit information related to the elements itemized above for fiscal year 1990 (and 1989, if possible). Thereafter, all sites will be required to submit this same information at quarterly intervals throughout the demonstration (collection

of baseline data with comparison to subsequent data will allow us to compare changes resulting from the demonstration). Each quarter will be sent to us no later than 3 months after the quarter's end. The sites will submit data for the quarter and totals for the entire demonstration to date.

Using the data base developed from the hospitals' data, we will trace changes in physician referral patterns, patient origin, patient satisfaction, and sources of payment over the course of the demonstration in order to evaluate the impact of the sites's marketing activities on attracting patients. In addition, we will examine differences in patient origin and volume between the demo sites and other hospitals in their MSAs using Medpar data (as described in Chapter 4). This data will be analyzed to determine if increases in volume and referral patterns can be attributed to the marketing efforts of the demo sites.

Information gathered through interviews at other sites (see Chapter 4) as well as during subsequent site visits will be evaluated in relation to the marketing efforts. For instance, we will attempt to determine if there have been any changes in physician referral patterns (i.e., are certain physicians who have multiple privileges in the community spending more or less time at the CABG sites? Are the other hospitals becoming more aggressive regarding the marketing programs, and their promotional efforts. Are they offering "extra" services similar to the demo sites?).

6.4 Patient/Physician Follow-up Survey

We will develop a patient/physician follow-up survey instrument to collect information from both beneficiaries and physicians. The survey, along with additional material required for OMB approval, will be developed during the twentieth contract month and submitted to the HCFA Project Officer for approval, then sent to OMB for clearance. The survey will be used to conduct telephone interviews of Medicare CABG patients at each demonstration site. We

will ultimately interview 40 patients from each demonstration site, selected randomly from a list of those who received CABGs. We will also interview 40 patients, identified from beneficiary records on the MedPAR file, who received CABGs at competing hospitals in the market area. As part of this survey, we will ask for information on referring physicians. Beneficiaries will be asked questions regarding the following issues:

- **Price.** The survey will include set of questions to determine whether price was an important factor in selecting the hospital. Components of price that might be important include deductibles, required copayments, and issues related to balance billing. Regardless of these factors, the beneficiary may also be influenced by the fact that the total price is known in advance.

  For beneficiaries not receiving care at the demonstration site, the survey will collect information on the total out-of-pocket costs to the beneficiary to make comparisons of price.

- **Role of referring physician.** The survey will ask the beneficiary a series of questions to determine what types of physicians influenced the decision to seek care at the hospital and how they influenced that decision. For example, a beneficiary may not have chosen a specific hospital, but may have been referred to a cardiothoracic surgeon who admits to only one hospital. Alternatively, the beneficiary could have selected a specialist based upon that physician's admitting privileges.
- **Income.** The survey will include questions related to income, availability of supplemental insurance, and other factors that might influence beneficiaries' price sensitivity.

- **Surgery circumstances.** The survey will collect information related to the circumstances under which the procedure was performed (e.g. were the circumstances urgent? was the beneficiary hospitalized when the decision for surgery was made? etc).

- **Hospital-related factors.** The survey will attempt to identify the importance of other hospital-related factors, e.g., the hospital's reputation, location, accessibility, availability of required services, etc. In addition, the survey will attempt to assess the importance of hospital marketing efforts.

- **Satisfaction.** The survey will collect information on the patients' satisfaction with the services received and their perceptions of the quality of care provided by both the hospital and the surgeon. In addition, the patient will provide answers to questions assessing the level of physical function achieved subsequent to surgery.

In addition to these specific questions, we will ask the beneficiary for the name of the referring physician. As a follow-up to the beneficiary survey, we will then survey a sub-set of 20 physicians at each site identified to gather information about their role in the selection of the hospital for the beneficiary. We will ask the physicians what factors influenced their choice of hospital, whether or not demonstration hospital marketing activities were important in their decision, and how price factors were considered in their recommendation.

With regard to quality, we will query the referring physician concerning delays in hospitalization, pre-admission communication with the demonstration site, perceived quality of care delivered, post-discharge communication with the demo site, post-discharge gaps in care, and continuity of care after discharge.

6.4.1 Scheduling of Interviews

The telephone interviews will be conducted during months 30 through 34 of the contract. We expect that interviews with beneficiaries will take between 30 to 45 minutes to complete. The surveys will reflect activity through the second year of the demonstration. During the interview, we will obtain the name and phone number of the referring physician. We will then conduct a one-half hour interview with the physician, linking data from the physician to the beneficiary in our data system. Budgeting for this task assumes that the total time required to complete the surveys is one hour for beneficiaries and two hours for physicians. This includes several attempts to reach the interviewees and completing the survey forms once that interview is completed.

We will conduct the interviews late in the project so that the effects of the demonstration will have been realized in the local health care markets and so that the beneficiary has time to assess satisfaction with the services received. In addition, it will take this long for

beneficiary records from competing hospitals to show up on the MEDPAR tapes.

6.5 Analysis of Survey Results

In the first phase of survey analysis, we will generate two types of descriptive tables. First, we will generate a series of descriptive tables comparing responses from beneficiaries selecting demonstration hospitals to beneficiaries selecting non-demonstration hospitals. These tables will include statistical analyses to identify areas of real difference between demonstration and non-demonstration beneficiary choice patterns. This analysis will be conducted using data pooled across demo sites.

Next, we will construct tables comparing the four demo sites to identify differences across hospitals and geographic areas. Included in this analysis, will be other information on the market areas related to demonstration sites. For example, we will compare data across sites related to number of competing hospitals, urban area size, etc.

In the second phase of survey analysis, we will develop a profit equation that will quantify the probability of a beneficiary selecting a demonstration site based upon several factors. We expect that this probability will be influenced by: the net price of the services to the beneficiary (deductibles, copayments, and other out-of-pocket expenditures including balance billing for physicians); beneficiary income and wealth; health status at the time of surgery decision; hospital distance; waiting time; awareness of hospital marketing efforts; referring physician specialty, and physician admitting privileges:

Pb(DEMO) = p(NP, W, HS, DIST, WAIT, AWARE, REFMD)

where:

Pb(DEMO)	=	the probability that a prospective CABG patient will select a demonstration site
NP	=	net out-of-pocket price for the inpatient Part A and B services

		facing the beneficiary
W	=	patient wealth
HS	=	patient health status
DIST	=	patient travel distance from the hospital
WAIT	=	number of days delay in receiving the operation
AWARE	=	patient awareness if price and quality differences between the demonstration hospital and other local competitors
REFMD	=	vector of characteristics of the referring physician that would affect choice

To estimate the model, beneficiary survey data will be pooled across all hospitals within the demo market sites. The dependent variable will equal one if the beneficiary chose a demo hospital; zero otherwise. Net price will be the sum of Part A and Part B inpatient bills that were paid out-of-pocket possibly zero in the demo hospital. Data for the other questions will be self-reported, with the exception of health status where we will have pre-admission data on many patients.

In addition to the variables listed in the predicting equation, we will include five market-area dummies to control for unmeasured site effects. If any of these dummy coefficients are significant, this will suggest other, unmeasured factors affecting choice that are systematic to the site. In this case, we will include other market-area variables and discuss the findings with demo hospital administrators in an attempt to explain the difference.

We will complete data analysis during months 34 through 39 so that information can be included in the final report.

7.0 MANAGEMENT PLAN

7.1 Organization of Evaluation

Robert Rubin, M.D., President of Health and Sciences Research, Incorporated, will serve as the overall Project Director. Three co-principal investigators will be responsible for carrying out all aspects of the evaluation: Jerry Cromwell, Ph.D., and William Stason, M.D., with the subcontractor, Health Economics Research, and Nancy Alfred Persily, M.P.H., with Lewin/ICF.

Dr. Cromwell will have responsibility for the design and analyses of demonstration price and volume effects detailed in Chapter 4 above. He will also be responsible for the completion of all data collection protocols, with the input of the other co-PIs. He will also take responsibility for any report concerning the addition of new demo sites. Dr. Cromwell will also assist Ms. Persily in the design and analysis of the beneficiary satisfaction survey and will participate in all on-site case study interviews with demo and competing non-demo hospitals.

Dr. Stason has two major responsibilities on the project: (1) patient outcomes; and (2) appropriateness of CABG surgery. He will have overall responsibility for the design and analysis of demo impacts on the quality of care, including mortality, morbidity, and patient functional status and satisfaction. He will also be responsible for designing and analyzing the appropriateness of CABG surgery, a task that was significantly expanded at the project's inception to include the development of appropriateness criteria based on expert physician panels. He will take responsibility for any PRO data collection design as well as detailed data requests regarding clinical indicators from the demo sites. As part of his evaluation of appropriateness, Dr. Stason will also be responsible for any changes in patient characteristics over the demonstration period.

Ms. Persily will be responsible for designing and analyzing demo effects on beneficiaries and their referring physicians as part of the overall evaluation of demo marketing efforts. She will review, critique, and evaluate the marketing efforts in each site through on-site case study interviews. She will also assemble marketing data from each site to produce site-specific patient profiles and referral patterns. In addition, Ms. Persily will act as overall project coordinator at Lewin/ICF.

7.2 Phasing of Tasks

The official start of the demonstration has been delayed until the Spring of 1991. Assuming a start date for the last of the four original demo sites of June 1, 1991, the demo is to run 36 months, or until June 1, 1994. With six months of post-demo evaluation analysis, the final deliverables would be submitted December 1, 1994.

In our revised budget submitted in April, 1991, we identified 15 tasks that covered the original RFP and the appropriateness modification. Two of these, the participation analysis and the replicability study, we have deleted as a cost-saving measure. This leaves 13 tasks. All preimplementation tasks have been completed, and this report constitutes the task 2 Design Report. The draft reports reviewing the appropriateness literature and criteria have also been submitted (or in the case of the latter, by the time this Design Report has been approved).

The Data Collection Protocols will be submitted by mid-June, 1991. Presumably, our involvement in adding sites will take place over the Summer and Fall, 1991.

We have proposed 3 site visits to each site. The initial site visit has already been completed. The next two visits will take place probably in the Summer of 1992 and then again in the Winter of 1993 near the end of the demonstration in order to capture mature demo effects.

The price/volume and quality analyses will be on-going as data come in from the sites on a quarterly basis. This will be in the nature of interim monitoring reports to HCFA. The final analyses will take place in the last six months of the evaluation.

The beneficiary and physician referral surveys are scheduled for the Winter of 1993, again after the programs have been running for at least 2 years and mature effects can be observed.

The Draft Final Evaluation Report will be submitted October 1, 1994, giving HCFA two months for review and comment. The Final Report incorporating these comments, plus new analyses completed in the last two months, will be submitted December 1, 1994.

7.3 Staffing by Task

Table 1 (based on revised budget submitted on March 14, 1991) gives a staffing of personnel by task. The case study hours include time for case study protocol design, site logistics, 3 site visits by the co-PIs, PRO arrangements while on site, 10 hours per site per team member on the initial site visit (already completed), 18 hours per site per member on the subsequent 2 visits, plus an additional 6 hours per site per team member for writing up notes after each visit. These site visits serve two very important functions. First, many aspects of this demonstration, its successes and failures, will not be revealed in the secondary data. How other hospitals react and compete with the demo hospitals in terms of marketing, etc., how demo hospitals reorganize departments and patient care to lower costs and improve quality, how physicians work together with the hospital to manage patients and split the global payment; how demo hospitals market the all-important Medicare Heart Bypass Center imprimatur; none of these questions can be addressed with secondary data. A second reason for two more site visits is to assure the availability and quality of data being submitted by the sites and for public relations. We feel it is crucial that HCFA, through its evaluator, maintain a regular, on-site

presence in these institutions. This demonstrates HCFA's commitment to the demo, to the demo sites in particular as they compete with other CABG providers, and to the outside world (i.e., other competitors, Congress, state officials) in assuring a thorough evaluation.

TABLE I

TABLE I

LEWIN/ICF Labor by Task. July 1, 1989 through September 30, 1994

Task	Rubin					Jones/Pomby					Kelley					Wells					Gold					Total
	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	
Pre-Implementation	112					140					208.8					73.8										536
Design		0					40					0					12									80
Data Protocol		0					40					0					4									82
Participation Analysis																										0
Adding Sites																										0
Case Study		12	12	12			60	60	60			20	20	20												276
Price/Volume Analysis		4	4	4																						12
Quality Analysis		4	4	4																						12
Beta Choice		12	12	12			40	60	100			40	120	120 [a]												578
Replicability																										0
Draft Final Report					10						68						0					24				100
Final Report					10						10						80					80				180
APPROPRIATENESS																										0
Literature Review	32					48						100											75			255
Criteria	4					4																				8
Model Testing		0	0	0	0						36															64
																										0
TOTAL	148	56	40	40	40	192	160	120	160	108	208.8	60	170	170	60	88.8	0	0	0	104	75	0	0	0	0	2142
Original Budget/Alloc	208					844					700					148					0					

TABLE I - Continued

TABLE I - Continued

	CROMWELL					STASOM					SCHNEIDER					BAKER					BUTRICA					BELL				
	Y0	Y1	Y2	Y3	Y4	Y0	Y1	Y2	Y3	Y4	Y0	Y1	Y2	Y3	Y4	Y0	Y1	Y2	Y3	Y4	Y0	Y1	Y2	Y3	Y4	Y0	Y1	Y2	Y3	Y4
Pre-Implem.	237					300[a]					329[a]										160[a]					330[a]				
Design	60						32					24															56				
Data Protocol	40						24					80									56						32			
Partic. Analysis							B			E		L		E		F		E		B							24			
Adding Sites	40						16																				108	68	68	
Case Studies[b]	120	104	104				88	96	96			48	172	172								56	52	52						
Price/Volume Analysis	40	120	120	160								100	12	120	148		160	160	160	130		160	120	120	80		32	32	32	32
Quality Analysis	8			16			80	60	60	80		80	60	60	76		40	40	40	40		100	100	100	60		60	40	40	36
Gene Choice	24		8	24																32									32
Reliability							B			E		L		E		T		E		B									
Draft Final Report				80						24						90									40				160
Final Report				24						8						16													24
Appropriateness Lit. Review	8					160																							
Appropriateness Criteria	8	8				156	16																						
Model Testing		40	20	20	40		32	24	24	40		80	60	60	80		100	80	80	90		60	60	60	60		24	24	24	40
TOTAL HOURS	253	300	244	253	360	616	280	180	180	152	329	308	412	412	402	0	300	280	280	300	160	432	332	332	240	518	368	164	164	324

Key: Y0 = Hours for period July 1, 1989 - March 1, 1991 (pre-implementation).
Y1 = March 1, 1991 - March 30, 1992
Y2 = April 1, 1992 - March 30, 1993
Y3 = April 1, 1992 - March 30, 1994
Y4 = April 1, 1994 - September 30, 1994

[a]Includes hours of several persons of equivalent training.

[b]Includes hours both as consultant and as employee.

[c]Hours include time for case study design, site logistics, 3 site visits, PRO arrangements, and 6 hours per site visit per team member for write-up. [illegible] per team member for first site visit and 10 hours per member for each subsequent visit.

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